WHAT IS CLAIMED IS:

1. A magnetoresistance effect element comprising:

a magnetoresistance effect film including a first ferromagnetic layer whose direction of magnetization is pinned substantially in one direction, a second ferromagnetic layer whose direction of magnetization changes in response to an external magnetic field, and an intermediate layer provided between the first and second ferromagnetic layers;

a pair of electrodes electrically coupled to the magnetoresistance effect film and configured to supply a sense current perpendicularly to a film plane of the magnetoresistance effect film; and

a phase separation layer provided between the pair of electrodes, the phase separation layer comprising a first phase and a second phase formed by a phase separation in a solid phase from an alloy including a plurality of elements, one of the first and second phases including at least one element selected from the group consisting of oxygen, nitrogen, fluorine and carbon in higher concentration than other of the first and second phases.

2. The magnetoresistance effect element according

to claim 1, wherein

the alloy includes at least one element selected from the first group consisting of silver, gold, platinum, palladium, iridium, osmium and copper, and at least one element selected from the second group consisting of nickel, iron and cobalt, and

in a case where the alloy is expressed by a formula $M_x(Ni_{100-y}(Fe_{100-z}Co_z)_y)_{100-x}$ where M denotes the element selected from the first group, the composition x is in a range between 1 atomic % and 50 atomic %, the composition y is in a range between 0 atomic % and 50 atomic %, and the composition z is in a range between 0 atomic % and 100 atomic %, or in a case where the alloy is expressed by a formula $M_u(Co_{100-v}(Fe_{100-w}Ni_w)_v)_{100-u}$ where M denotes the element selected from the first group, the composition u is in a range between 1 atomic % and 50 atomic %, the composition v is in a range between 0 atomic % and 50 atomic %, and the composition w is in a range between 0 atomic % and 100 atomic %.

3. The magnetoresistance effect element according to claim 1, wherein

the alloy includes aluminum, at least one element selected from the first group consisting of silver, gold, platinum, palladium, iridium, osmium and copper, and at least one element selected from the second group

consisting of magnesium, calcium, silicon, germanium, boron, tantalum, tungsten, niobium, zirconium, titan, chromium, zinc, lithium and gallium, and

in a case where the alloy is expressed by a formula $(Al_{100-y}Q_y)_{100-x}M_x$ where M denotes the element selected from the first group and Q denotes the elements selected from the second group, the composition x is in a range between 1 atomic % and 40 atomic %, and the composition y is in a range between 0 atomic % and 30 atomic %.

4. The magnetoresistance effect element according to claim 1, wherein

the alloy includes magnesium, at least one element selected from the first group consisting of silver, gold, platinum, palladium, iridium, osmium and copper, and at least one element selected from the second group consisting of aluminum, calcium, silicon, germanium, boron, tantalum, tungsten, niobium, zirconium, titan, chromium, zinc, lithium and gallium, and

in a case where the alloy is expressed by a formula $(Mg_{100-y}Q_y)_{100-x}M_x$ where M denotes the element selected from the first group and Q denotes the elements selected from the second group, the composition x is in a range between 1 atomic % and 40 atomic %, and the composition y is in a range between 0 atomic % and 30 atomic %.

5. The magnetoresistance effect element according to claim 1, wherein

the alloy includes silicon, at least one element selected from the first group consisting of silver, gold, platinum, palladium, iridium, osmium and copper, and at least one element selected from the second group consisting of magnesium, calcium, aluminum, germanium, boron, tantalum, tungsten, niobium, zirconium, titan, chromium, zinc, lithium and gallium, and

in a case where the alloy is expressed by a formula $(Si_{100-y}Q_y)_{100-x}M_x$ where M denotes the element selected from the first group and Q denotes the elements selected from the second group, the composition x is in a range between 1 atomic % and 40 atomic %, and the composition y is in a range between 0 atomic % and 30 atomic %.

6. The magnetoresistance effect element according to claim 1, wherein

the other of the first and second phases includes an magnetic element in higher concentration than the one of the first and second phases.

7. The magnetoresistance effect element according to claim 6, wherein

the other of the first and second phases is dotted in the one of the first and second phases, and is

forming a magnetic contact connecting the first and the second ferromagnetic layers.

8. The magnetoresistance effect element according to claim 1, wherein

the alloy includes iron, and at least one element selected from the group consisting of molybdenum, magnesium, calcium, titan, zirconium, niobium, hafnium, tantalum, boron, aluminum and silicon, and

in a case where the alloy is expressed by a formula $M_{100-x}Fe_x$ where M denotes the element selected from the group, the composition x is in a range between 1 atomic % and 50 atomic %.

9. The magnetoresistance effect element according to claim 1, wherein the alloy includes nickel, and at least one element selected from the group consisting of molybdenum, magnesium, tungsten, titan, zirconium, niobium, hafnium, tantalum, boron, aluminum and silicon, and

in a case where the alloy is expressed by a formula $M_{100-x}Ni_x$ where M denotes the element selected from the group, the composition x is in a range between 1 atomic % and 50 atomic %.

10. The magnetoresistance effect element according

to claim 1, wherein the alloy includes cobalt, and at least one element selected from the group consisting of molybdenum, magnesium, tungsten, titan, zirconium, niobium, hafnium, tantalum, boron, aluminum , chromium and vanadium, and

in a case where the alloy is expressed by a formula $M_{100-x}Co_x$ where M denotes the element selected from the group, the composition x is in a range between 1 atomic % and 50 atomic %.

11. The magnetoresistance effect element according to claim 1, wherein

the phase separation layer has a lamination of a first layer and a second layer,

the first layer includes a plurality of phases formed by a phase separation in a solid phase from a first alloy, and

the second layer includes a plurality of phases formed by a phase separation in a solid phase from a second alloy different from the first alloy.

12. The magnetoresistance effect element according to claim 1, wherein

an average grain size of the other of the first and second phases is not smaller than 0.8 times thickness of the phase separation layer and is not larger than four

times thickness of the phase separation layer, and

an average spacing of the other of the first and second phases is in a range between 1nm and 10 nm.

13. The magnetoresistance effect element according to claim 1, wherein

an average spacing of the other of the first and second phases is smaller than average crystal grain sizes of the first and second ferromagnetic layers.

14. A magnetoresistance effect element comprising:

a magnetoresistance effect film including a first ferromagnetic layer whose direction of magnetization is pinned substantially in one direction, a second ferromagnetic layer whose direction of magnetization changes in response to an external magnetic field, and an intermediate layer provided between the first and second ferromagnetic layers;

a pair of electrodes electrically coupled to the magnetoresistance effect film and configured to supply a sense current perpendicularly to a film plane of the magnetoresistance effect film;

a magnetic layer provided between the pair of electrodes, the magnetic layer comprising a first region and a second region, the first region including at least one element selected from the group consisting of oxygen,

nitrogen, fluorine and carbon in higher concentration than the second region; and

a magnetic coupling interception layer provided between the magnetic layer and the first or second ferromagnetic layer.

15. A magnetoresistance effect element comprising:

a magnetoresistance effect film including a first ferromagnetic layer whose direction of magnetization is pinned substantially in one direction, a second ferromagnetic layer whose direction of magnetization changes in response to an external magnetic field, and an intermediate layer provided between the first and second ferromagnetic layers;

a pair of electrodes electrically coupled to the magnetoresistance effect film and configured to supply a sense current perpendicularly to a film plane of the magnetoresistance effect film;

a magnetic layer provided between the pair of electrodes, the magnetic layer comprising a first region and a second region, the first region including at least one element selected from the group consisting of oxygen, nitrogen, fluorine and carbon in higher concentration than the second region; and

a layer provided between the magnetic layer and the first or second ferromagnetic layer, the layer having a

thickness between 1nm and 3nm and including at least one element selected from the group consisting of copper, gold, silver, rhenium, osmium, ruthenium, iridium, palladium, chromium, magnesium, aluminum, rhodium and platinum.

16. A method of manufacturing a magnetoresistance effect element comprising a magnetoresistance effect film including a first ferromagnetic layer whose direction of magnetization is pinned substantially in one direction, a second ferromagnetic layer whose direction of magnetization changes in response to an external magnetic field, and an intermediate layer provided between the first and second ferromagnetic layers, a pair of electrodes electrically coupled to the magnetoresistance effect film and configured to supply a sense current perpendicularly to a film plane of the magnetoresistance effect film, comprising:

distributing a first and second phases in a film plane by inducing a phase separation in a layer made of an alloy including a plurality of elements

17. The method of manufacturing a magnetoresistance effect element according to claim 16, further comprising:

making at least one element selected from the group

consisting of oxygen, nitrogen, fluorine and carbon react preferentially with one of the first and second phases.

18. The method of manufacturing a magnetoresistance effect element according to claim 17, wherein making radical of the element to make the element react with the one of the first and second phases.

19. A magnetic head comprising a magnetoresistance effect element comprising:

a magnetoresistance effect film including a first ferromagnetic layer whose direction of magnetization is pinned substantially in one direction, a second ferromagnetic layer whose direction of magnetization changes in response to an external magnetic field, and an intermediate layer provided between the first and second ferromagnetic layers;

a pair of electrodes electrically coupled to the magnetoresistance effect film and configured to supply a sense current perpendicularly to a film plane of the magnetoresistance effect film; and

a phase separation layer provided between the pair of electrodes, the phase separation layer comprising a first phase and a second phase formed by a phase

separation in a solid phase from an alloy including a plurality of elements, one of the first and second phases including at least one element selected from the group consisting of oxygen, nitrogen, fluorine and carbon in higher concentration than other of the first and second phases.

20. A magnetic reproducing apparatus which reads magnetic information in a magnetic recording medium,

the magnetic reproducing apparatus comprising a magnetoresistance effect element for reading the magnetic information comprising:

a magnetoresistance effect film including a first ferromagnetic layer whose direction of magnetization is pinned substantially in one direction, a second ferromagnetic layer whose direction of magnetization changes in response to an external magnetic field, and an intermediate layer provided between the first and second ferromagnetic layers;

a pair of electrodes electrically coupled to the magnetoresistance effect film and configured to supply a sense current perpendicularly to a film plane of the magnetoresistance effect film; and

a phase separation layer provided between the pair of electrodes, the phase separation layer comprising a first phase and a second phase formed by a phase

separation in a solid phase from an alloy including a plurality of elements, one of the first and second phases including at least one element selected from the group consisting of oxygen, nitrogen, fluorine and carbon in higher concentration than other of the first and second phases.